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Montana. State
Water Projects
Bureau
Nilan Reservoir
East Dam and North
Dam

NILAN RESERVOIR

EAST DAM *and* **NORTH DAM**

Manual for Operation and Maintenance

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OVERVIEW

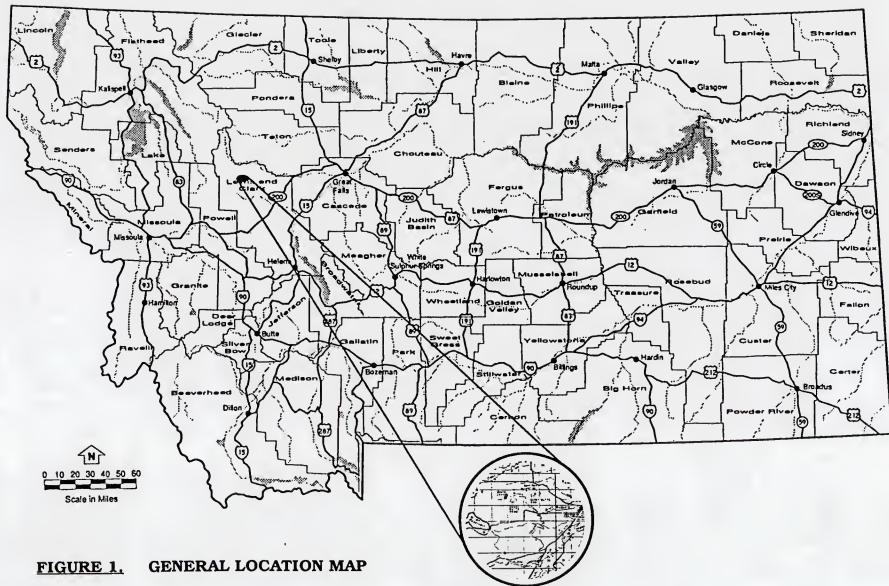
Both dams on Nilan Reservoir are located in Lewis and Clark County approximately 7 miles upstream of the town of Augusta. This off-stream reservoir is fed by a supply canal from Smith Creek and Ford Creek. The Nilan Water Users Association (herein called "association") operates the dams. There is a distribution canal located at the outlet for each dam.

Both earthfill dams were completed in 1951. Nilan East Dam is 51 feet high and 1,010 feet long, while the North Dam is 54 feet high and 530 feet long. Appurtenant to the North Dam is a 1,300-foot-long dike, which extends generally east from the east abutment along a low area in the topography. The dike has the same crest elevation as the North Dam and has a maximum height of 8 feet, with the same side slopes and crest width as the dam. The outlet works of each dam consist of a double-chambered wet tower and a 48-inch diameter slide gate with a 48-inch square emergency slide gate. Controls for both gates are at the top of the tower. The maximum capacity of the East Dam outlet is 385 cubic feet per second (cfs) and the maximum capacity of the North Dam outlet is 395 cfs.

The spillway, located in a natural swale approximately 370 feet northwest of the north abutment of the East Dam, releases water into the Elk Creek drainage.

The spillway has a concrete control section which functions as a low drop structure, 1.8 feet high, 72 feet long and 0.75 feet wide. The maximum capacity of the spillway is 8,620 cfs.

Water from the reservoir is primarily used for irrigation water supply. The reservoir also is used for water-based recreation.



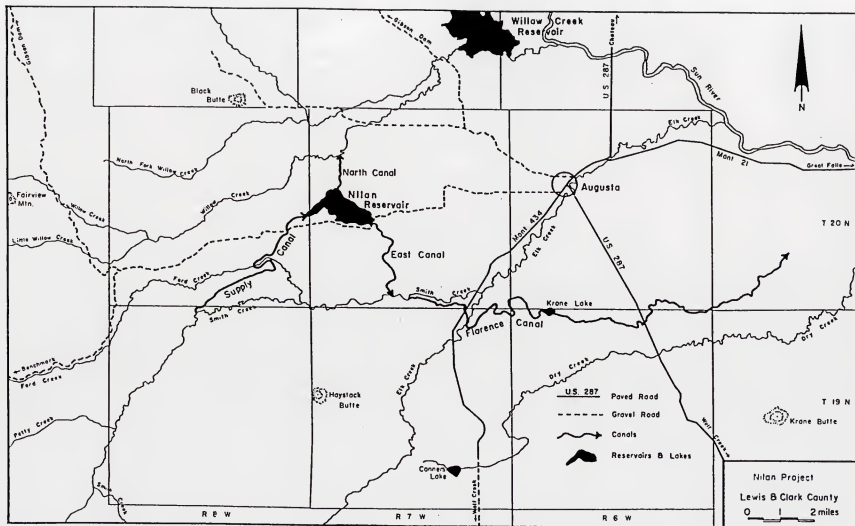


FIGURE 2. PROJECT AREA MAP

STATISTICAL INFORMATION

1. General

- | | |
|--|--|
| a) Owner | Montana Department of
Natural Resources and
Conservation
(DNRC) |
| b) Operator | Nilan Water Users Association |
| c) Location | Sections 17, 18 (North Dam),
19, and 20 (East Dam),
Township 20 North, Range 7
West |
| d) Latitude, East Dam
Longitude, East Dam | 47° 28' 24"
112° 31' 00" |
| e) Latitude, North Dam
Longitude, North Dam | 47° 29' 12"
112° 32' 18" |
| f) County--State | Lewis and Clark--Montana |
| g) Watershed Location | Between Willow Creek and Elk
Creek, Sun River basin |
| h) Drainage Area | 3.55 square miles |

2. Principal Elevations (feet above mean sea level)

- | | |
|----------------------|--------------|
| a) Minimum Dam Crest | 4,452.0 feet |
| b) Normal Full Pool | 4,442.5 feet |

3. Reservoir

- | | |
|--|------------------------|
| a) Length of Maximum
Pool (approximate) | 0.78 miles |
| b) Maximum Reservoir
Level of Record | 4,442.9 feet (7-15-78) |
-
-

-
- | | |
|--------------------------------|-----------|
| c) Surface Area at Normal Pool | 525 acres |
|--------------------------------|-----------|

4. Storage

- | | |
|----------------------|--|
| a) Maximum Storage | 15,600 acre-feet
(elevation 4,452.0 feet) |
| b) Active Storage | 10,092 acre-feet
(elevation 4,442.5 feet) |
| c) Maximum Surcharge | 5,508 acre-feet
(elevation 4,452.0 feet) |

5. Hydrology

- | | |
|------------------------|---|
| a) Inflow Design Flood | 1/2 Probable Maximum Flood
(1/2 PMF) (12,400 cubic feet
per second (cfs) peak flow) |
|------------------------|---|

6. Embankment (East Dam)

- | | |
|---------------------|----------------------------|
| a) Type | Earthfill |
| b) Hydraulic Height | 51 feet |
| c) Crest Length | 1,010 feet |
| d) Crest Width | 20 feet |
| e) Upstream Slope | 1v on 2h and
1v on 1.8h |
| f) Downstream Slope | 1v on 2h |

7. Embankment (North Dam)

- | | |
|---------------------|-----------|
| a) Type | Earthfill |
| b) Hydraulic Height | 54 feet |
-

-
- | | |
|---------------------|------------|
| c) Crest Length | 530 feet |
| d) Crest Width | 20 feet |
| e) Downstream Slope | 1v on 2.0h |
| f) Upstream Slope | 1v on 2.0h |

8. Embankment (North Dike)

- | | |
|---------------------|------------|
| a) Type | Earthfill |
| b) Hydraulic Height | 8 feet |
| c) Crest Length | 1,300 feet |
| d) Crest Width | 20 feet |
| e) Downstream Slope | 1v on 2.0h |
| f) Upstream Slope | 1v on 2.0h |

9. Outlet Works (East Dam)

- | | |
|---|---|
| a) Size | 4-foot diameter, cast-in-place concrete conduit |
| b) Length | 250 feet |
| c) Control | Double-chambered wet well located on the upstream edge of dam crest with a 48-inch diameter operating sluice gate and a 48-inch by 48-inch square emergency sluice gate |
| d) Capacity at Dam Crest Elevation 4,452.0 Feet | 385 cfs |
| e) Design Invert Elevation | 4,400.75 feet |
| f) Trashrack | Yes |
-

10. Outlet Works (North Dam)

- | | |
|---|---|
| a) Size | 4-foot diameter, cast-in-place concrete conduit |
| b) Length | 626 feet |
| c) Control | Double-chambered wet well located on the upstream edge of dam crest with a 48-inch diameter operating sluice gate and a 48-inch by 48-inch square emergency sluice gate |
| d) Capacity at Dam Crest Elevation 4,452.0 Feet | 395 cfs |
| e) Design Invert Elevation | 4,397.25 feet |
| f) Trashrack | Yes |

11. Spillway

- | | |
|--|--|
| a) Type | Unlined channel with concrete control weir |
| b) Crest Width | 72 feet |
| c) Crest Elevation | 4,442.5 feet |
| d) Capacity at Dam Crest Elevation 4452.0 Feet | 8,620 cfs |

OPERATING PROCEDURES

The association operates the Nilan Dams and reservoir to provide an adequate supply of irrigation water to meet contracts with the water users without exceeding safe storage and flow levels.

Method and Schedule of Operation

The association's goal is to have the reservoir full before contract holders start putting in calls for water. For the past several years, the inlet canal rarely has been turned off. The inlet canal is operated during the winter as long as icing is not a problem. Even when icing does occur, some water continues to run through the canal under the ice.

The date irrigation releases begin varies from year to year, with late April being the earliest for the East Dam and late May for the North Dam. During typical years, releases begin around June 1st. Irrigation releases usually end by October 1. Naturally these dates vary depending on each year's climatological and hydrological conditions.

The maximum reservoir elevation for winter storage is 4,437.0 feet with 7,407 acre-feet of storage. This winter maximum helps prevent damage to the riprap and embankment from wind-driven waves and ice. The minimum reservoir elevation for winter storage is 4,416.0 feet with 1,370 acre-feet of storage. This winter minimum helps prevent ice damage to the inlet structure for the outlet works.

Safe Drawdown

Because neither of the Nilan Dams has been thoroughly investigated relative to their structural stability, DNRC recommends that drawdown rates not exceed one foot per day.

Limitation of Appurtenances

Appurtenances at Nilan Reservoir include the supply and delivery canals, spillway, and the outlet works. The maximum combined capacity of the delivery canals is 149 cfs. At the maximum dam crest elevation, the combined outlet works' capacity is 780 cfs. In addition, the spillway will discharge 8,620 cfs at the minimum dam crest elevation. If the outlet works are operated far in excess of the delivery canals' capacity, the canals and structures can be damaged. The supply canal's capacity is listed as 300 cfs. An outlet rating table is shown in Appendix A.

The maximum gate opening for all of the gates on the project is 4 feet. Openings in excess of this amount may damage the gates, gate frames, gate stems or the gate operating pedestals. The 4 feet of operation is measured on the exposed portion of the gate stem between the top of the pedestal and the bottom of the stop nut.

Dam Operator

The responsibility for the daily operation of the dams and reservoir rests with the association and its dam operator. The dam operator is generally authorized to operate the reservoir to meet the association's

goal of providing an adequate supply of irrigation water to meet contracts with the water users without exceeding safe storage and flow levels. The dam operator's specific responsibilities are to:

1. *Operate the mechanical features of the outlet works.*
2. *Coordinate filling the reservoir and releasing the water.*
3. *Notify the State Water Projects Bureau (SWPB) of unusual occurrences such as impending floods, excessive seepage, if the spillway is flowing, etc.*
4. *Perform various maintenance tasks.*
5. *Maintain water level records and report the findings to the SWPB.* Normally water level measurements are taken monthly during the irrigation season. A continuous recorder is also maintained on the supply canal and monitored by the dam operator. Readings are typically reported to the SWPB the first of each month during the irrigation season.
6. *Monitor weather conditions.*
7. *Monitor seepage.*

It should be noted that the present dam operator started working in late-1984 when the previous operator was hospitalized. Consequently, the present dam operator learned primarily by trial and error with some guidance from the association.

Typically, the out-going dam operator, the association, and the SWPB train a new dam operator. The dam operator's training focuses on the mechanical operation of the gates, measurement of the storage level,

measurement of the rate of water release, and record keeping. The outlet gates are operated manually with a hand crank.

The outlet works are intended to be used for controlling the release of irrigation water and not for providing emergency relief. If the outlet works are operated for emergency relief beyond the capacity of the outlet canals, the canals and structures below the dams would be damaged.

The dam operator is normally available daily to observe the dams and perform operating functions during the filling and irrigation seasons, and is available several times per month at other times of the year. Communication among the dam operator, the association, and the SWPB usually takes place by telephone. Although radio communications are not routinely available, during emergencies or unusual occurrences, radio communication may be established so the dam operator can speak directly with county authorities and communicate indirectly with the SWPB (see Nilan Reservoir East Dam and North Dam Emergency Plan).

Weather Monitoring

The dam operator monitors weather conditions through local weather forecasts and the National Weather Service.

Interaction With Other Dams

Willow Creek Dam and Reservoir is approximately 6.2 miles downstream from the Nilan North Dam. Greenfields Irrigation District

operates Willow Creek Dam. The safety of Willow Creek Dam is not affected by the Nilan North Dam during normal operations. If, however, the Nilan North Dam breaches, at least 10,000 cfs would be routed through Willow Creek Dam. (See Nilan Reservoir East Dam and North Dam Emergency Plan). Under such an emergency, the safety of Willow Creek Dam could be jeopardized. Therefore, if it appears the Nilan North Dam will breach, the dam operator should immediately notify Scott Boelman, manager of Greenfields Irrigation District (office: 406-467-2533, home: 406-467-3292). There are no dams below the Nilan East Dam. There are no dams upstream of Nilan Reservoir.

INSPECTION AND MONITORING

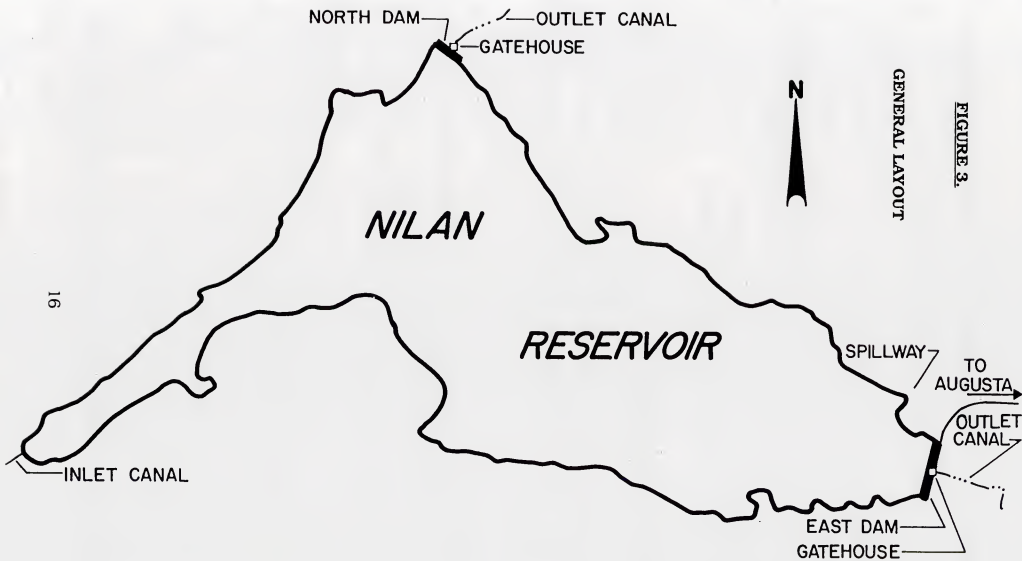
The SWPB will inspect the dams annually. Appendix B includes an example of a SWPB inspection checklist. In addition to annual inspections, SWPB personnel will inspect the dams and reservoir during and after heavy runoff, severe rainstorms, and severe windstorms; during high storage periods; and after an earthquake. The embankments are not monitored by instrumentation.

Structural Features Inspection

Structural features include the gatehouses, spillway, and outlet works (Figure 3). The SWPB will inspect these structures annually as part of its inspection program. Items checked or noted include, but are not limited to:

1. *Outlet Works*

- a) Any differential settlement or movement resulting in cracking of the conduits
 - b) Erosion of the seals or the conduits by cavitation immediately downstream of the gates
 - c) Major seepage of water into the conduits
 - d) Major deterioration of exposed concrete due to freeze/thaw cycles or sulfate reactions
 - e) Operation of the gates through a full cycle
 - f) Corrosion of any metal
 - g) Proper lubrication of the pedestals
 - h) Air vents for unobstructed flow
-



GENERAL LAYOUT

FIGURE 3.

-
2. *GateHouses* — any damage or vandalism
 3. *Spillway*
 - a) Erosion of the spillway channel
 - b) Blockage of the approach or exit channel
 - c) Deterioration of concrete

Riprap Inspection

The riprap along the face of each dam should be at least 30 inches thick. Immediately after the occurrence of high water, the riprap will be inspected and additional riprap added if needed.

Seepage Monitoring

Minor seepage has been observed at the toe of the North Dam embankment around the conduit outlet headwall. When this location seeps, the amount usually is 2 gallons per minute (gpm) or less. The seepage will be observed and monitored by the dam operator during regular visits and by the SWPB during annual inspections. Seepage measuring equipment has not been installed at either dam.



MAINTENANCE

The association is responsible for routine maintenance of the project. During regular visits, the dam operator will identify and perform normal maintenance activities. During the annual inspections, the SWPB will also identify items that need maintenance or repair. The SWPB may supervise major repairs.

Routine Maintenance

As soon as a need is identified, the dam operator will perform any routine maintenance necessary to protect the dams or keep them in good working order. The dam operator will watch for any potential maintenance requirements during normal visits to the dams. Items that may occasionally need attention include, but are not limited to:

1. *Lubrication of gate-operating mechanisms.*
 2. *Debris or silt restricting the supply canal, spillway inlet or the outlet works.* Accumulated debris that could affect the operation of these appurtenances will be removed at once, with all debris removed at least annually.
 3. *Erosion gullies on embankments.* Development of erosion gullies will be checked immediately. Gullies will be filled, compacted, and seeded. Particular attention will be paid to the abutment contact areas and the downstream faces where four-wheel-drive tracks may become a problem.
 4. *Rodent damage.* Rodent burrows will be filled immediately and the rodents destroyed.
 5. *Upstream slope riprap.* Reservoir riprap normally will be maintained annually, but may occasionally need repairs because of high water or wave action.
-
-

-
-
6. *Vegetative cover on downstream slopes.* Good vegetative cover will be maintained, but large brush will be removed.

Annual Maintenance

The SWPB will conduct annual inspections of the Nilan Dams and Reservoir. During these inspections, any items requiring maintenance will be identified and recorded. Items needing annual maintenance include the spillway, outlet works, gates, riprap, roads, and gatehouses. Any other routine items that need immediate attention, such as removing trees or brush, will also be noted.

After the association receives the inspection report from the SWPB, it will develop a maintenance schedule for the identified items. While the dam operator or association members may perform these small or routine tasks, major repairs are more likely to be handled by a contractor. The SWPB may assist in contracting for repairs and may supervise the repair work.

Record Keeping

The SWPB will maintain records—including photographs—of all inspections and maintenance requirements. These records will also include flow measurements and storage volumes. Anyone who wants to review these records may do so in the SWPB's office at the Department of Natural Resources and Conservation in Helena.

The dam operator will keep records of the reservoir elevation, seepage observations or measurements, and any unusual conditions. These records may be reviewed at the dam operator's house.

REFERENCES

- Artz, Bert, Nilan dam operator. September 1993 and February 1994.
Personal telephone conversation and meeting with Marvin Cross,
Havre regional office civil engineering specialist, Water Resources
Division, DNRC, Havre.
- Morrison-Maierle, Inc. July 1981. *Phase 1 Inspection Report*, National
Dam Safety Program, Elk Creek Basin, Nilan East Dam, MT-14,
Willow Creek Basin, Nilan North Dam, MT-3206, Augusta, Mon-
tana. Prepared for the State of Montana (DNRC) under the U.S.
Army Corps of Engineers National Dam Safety Program.

APPENDIX A

RATING CURVES AND TABLES

TABLE A-1

NILAN DAMS / ACTIVE STORAGE IN ACRE-FEET

<u>ELEV.</u>	<u>0.0</u>	<u>0.1</u>	<u>0.2</u>	<u>0.3</u>	<u>0.4</u>	<u>0.5</u>	<u>0.6</u>	<u>0.7</u>	<u>0.8</u>	<u>0.9</u>
4.401	0	3	6	9	12	15	18	21	24	27
4.402	30	34	39	43	48	52	57	61	66	70
4.403	75	80	86	91	97	102	108	113	119	124
4.404	130	136	143	149	156	162	168	175	181	188
4.405	194	201	207	214	220	227	234	240	247	253
4.406	260	268	276	284	292	300	308	316	324	332
4.407	340	349	358	367	376	385	394	403	412	421
4.408	430	439	449	458	468	477	487	496	506	515
4.409	525	534	544	554	563	573	583	592	602	611
4.410	621	631	641	651	661	670	680	690	700	710
4.411	720	731	742	753	764	775	786	797	808	819
4.412	830	842	854	866	878	890	902	914	926	938
4.413	950	963	976	989	1,002	1,015	1,028	1,041	1,054	1,067
4.414	1,080	1,094	1,108	1,122	1,136	1,150	1,164	1,178	1,192	1,206
4.415	1,220	1,235	1,250	1,265	1,280	1,295	1,310	1,325	1,340	1,355
4.416	1,370	1,386	1,402	1,418	1,434	1,450	1,466	1,482	1,498	1,514
4.417	1,530	1,547	1,564	1,581	1,598	1,615	1,632	1,649	1,666	1,683
4.418	1,700	1,718	1,736	1,754	1,772	1,790	1,808	1,826	1,844	1,862
4.419	1,880	1,899	1,917	1,936	1,955	1,973	1,992	2,011	2,030	2,048
4.420	2,067	2,088	2,109	2,130	2,151	2,172	2,193	2,214	2,235	2,256
4.421	2,277	2,299	2,321	2,343	2,365	2,387	2,410	2,432	2,454	2,476
4.422	2,498	2,521	2,544	2,567	2,590	2,613	2,636	2,659	2,682	2,705
4.423	2,728	2,752	2,777	2,801	2,825	2,850	2,875	2,899	2,924	2,948
4.424	2,973	3,000	3,027	3,054	3,081	3,108	3,135	3,162	3,189	3,216
4.425	3,243	3,271	3,299	3,327	3,355	3,383	3,411	3,439	3,467	3,495
4.426	3,523	3,552	3,581	3,610	3,639	3,668	3,697	3,726	3,755	3,784
4.427	3,813	3,842	3,871	3,900	3,929	3,958	3,987	4,016	4,045	4,074
4.428	4,103	4,132	4,163	4,193	4,223	4,252	4,282	4,312	4,342	4,372
4.429	4,402	4,432	4,462	4,492	4,522	4,552	4,582	4,612	4,642	4,672
4.430	4,702	4,733	4,765	4,796	4,828	4,859	4,891	4,922	4,954	4,985
4.431	5,017	5,051	5,086	5,120	5,155	5,189	5,224	5,258	5,293	5,327
4.432	5,362	5,399	5,436	5,473	5,510	5,547	5,584	5,621	5,658	5,695
4.433	5,732	5,771	5,811	5,850	5,890	5,929	5,969	6,008	6,048	6,087
4.434	6,127	6,168	6,210	6,251	6,293	6,334	6,376	6,417	6,459	6,500
4.435	6,542	6,584	6,627	6,669	6,712	6,754	6,797	6,839	6,882	6,924
4.436	6,967	7,011	7,055	7,099	7,143	7,187	7,231	7,275	7,319	7,363
4.437	7,407	7,452	7,497	7,542	7,587	7,632	7,677	7,722	7,767	7,812
4.438	7,857	7,903	7,949	7,995	8,041	8,087	8,133	8,179	8,225	8,271
4.439	8,317	8,364	8,412	8,459	8,507	8,554	8,602	8,649	8,697	8,744
4.440	8,792	8,841	8,890	8,939	8,988	9,037	9,086	9,135	9,184	9,233
4.441	9,282	9,332	9,383	9,433	9,484	9,534	9,585	9,635	9,686	9,736
4.442	9,787	9,848	9,909	9,970	10,031	10,092	10,153	10,214	10,275	10,336

Top of grillage elevation 4,452.0 / Concrete crest elevation 4,442.5

TABLE A-2

NILAN DAMS / LIVE STORAGE TABLE

<u>Slope Distance</u>	<u>Elevation [Feet]</u>	<u>Contents [Acre-feet]</u>	<u>Slope Distance</u>	<u>Elevation [Feet]</u>	<u>Contents [Acre-feet]</u>
0+00	4,445.62	Top of Block #1 9,772	+60	4,435.55	6,776
0+14	41.97		+61	35.48	6,746
+15	41.91		+62	35.39	6,708
+16	41.64		+63	35.32	6,678
+17	41.60		+64	35.25	6,648
+18	41.50		+65	35.18	6,618
+19	41.45		+66	35.06	6,567
0+20	41.39		+67	34.95	6,521
+21	41.31		+68	34.84	6,475
+22	41.18		+69	34.51	6,338
+23	40.89	9,228	0+70	34.45	6,314
+24	40.77	9,169	+71	34.26	6,235
+25	40.76	9,164	+72	34.08	6,160
+26	40.65	9,111	+73	33.90	6,087
+27	40.61	9,091	+74	33.71	6,040
+28	40.47	9,071	+75	33.42	5,898
+29	40.23	8,905	+76	33.22	5,819
0+30	40.13	8,846	+77	33.11	5,775
+31	40.10	8,841	+78	32.89	5,693
+32	39.87	8,730	+79	32.88	5,689
+33	39.65	8,626	0+80	32.81	5,662
+34	39.52	8,563	+81	32.44	5,525
+35	39.40	8,507	+82	32.41	5,514
+36	39.25	8,436	+83	32.28	5,466
+37	39.19	8,406	+84	32.07	5,388
+38	39.16	8,392	+85	31.99	5,359
+39	39.01	8,322	+86	31.80	5,293
0+40	38.91	8,276	+87	31.73	5,269
+41	38.80	8,225	+88	31.60	5,224
+42	38.32	8,004	+89	31.49	5,186
+43	38.23	7,963	0+90	31.36	5,141
+44	38.17	7,935	+91	31.26	5,106
+45	38.16	7,931	+92	31.16	5,072
+46	37.93	7,826	+93	31.06	5,037
+47	37.59	7,673	+94	31.01	5,020
+48	37.36	7,569	+95	30.90	4,985
+49	37.12	7,461	+96	30.81	4,957
0+50	37.12	7,461	+97	30.70	4,922
+51	37.10	7,452	+98	30.59	4,888
+52	36.93	7,376	+99	30.32	4,802
+53	36.75	7,297	1+00	30.30	4,796
+54	36.59	7,227	+01	30.10	4,733
+55	36.35	7,121	+02	30.02	4,708
+56	36.25	7,077	+03	29.87	4,663
+57	35.99	6,963	+04	29.72	4,618
+58	35.80	6,882	+05	29.59	4,579
+59	35.70	6,839	+06	29.46	4,540

TABLE A-2 Continued

<u>Slope Distance</u>	<u>Elevation (Feet)</u>	<u>Contents (Acre-feet)</u>	<u>Slope Distance</u>	<u>Elevation (Feet)</u>	<u>Contents (Acre-feet)</u>
+07	4,429.29	4.489	1+52	4,419.24	1.925
+08	29.05	4.417	+53	18.97	1.875
+09	28.89	4.369	+54	18.85	1.853
1+10	28.70	4.312	+55	18.79	1.842
+11	28.37	4.214	+56	18.74	1.833
+12	28.08	4.128	+57	18.69	1.824
+13	27.79	4.042	+58	18.65	1.817
+14	27.62	3.993	+59	18.64	1.815
+15	27.45	3.944	1+60	18.62	1.812
+16	27.19	3.868	+61	18.62	1.812
+17	26.86	3.772	+62	18.62	1.812
+18	26.54	3.680	+63	18.60	1.808
+19	26.42	3.645	+64	18.53	1.795
1+20	26.05	3.538	+65	18.45	1.781
+21	25.87	3.487	+66	18.43	1.777
+22	25.67	3.431	+67	18.23	1.741
+23	25.41	3.358	+68	18.08	1.714
+24	25.13	3.279	+69	17.62	1.635
+25	24.87	3.208	1+70	17.25	1.573
+26	24.71	3.165	+71	16.76	1.492
+27	24.32	3.059	+72	16.34	1.424
+28	24.10	3.000	+73	16.06	1.380
+29	23.86	2.938	+74	15.68	1.322
1+30	23.56	2.865	+75	14.90	1.206
+31	23.32	2.806	+76	14.72	1.181
+32	23.12	2.757	+77	14.06	1.088
+33	22.75	2.671	+78	13.67	1.037
+34	22.51	2.615	+79	13.33	993
+35	22.35	2.579	1+80	12.78	924
+36	22.03	2.505	+81	12.48	888
+37	21.76	2.445	+82	12.03	834
+38	21.30	2.343	+83	11.52	777
+39	21.09	2.297	+84	11.09	730
1+40	20.92	2.260	+85	10.72	692
+41	20.80	2.235	+86	10.28	649
+42	20.59	2.191	+87	10.02	621
+43	20.41	2.153	+88	09.74	596
+44	20.16	2.101	+89	09.17	541
+45	20.02	2.071	1+90	08.39	467
+46	19.90	2.048	+91	08.22	451
+47	19.78	2.026	+92	07.87	418
+48	19.68	2.007	+93	07.48	383
+49	19.56	1.984	+94	06.58	306
1+50	19.54	1.981	2+00	10.44	665
+51	19.27	1.930			

Top of
Block #4

Top of
Cane
Inlet

TABLE A-3**NILAN DAMS
OUTLET RATING TABLE**

<u>EAST DAM</u>		<u>NORTH DAM</u>	
Elevation (feet)	Flow (cfs)	Elevation (feet)	Flow (cfs)
4,400.75	0	4,397.75	0
4,411.40	150	4,408.50	150
4,424.00	250	4,421.30	250
4,432.90	300	4,430.40	300
4,452.00	385	4,452.00	395

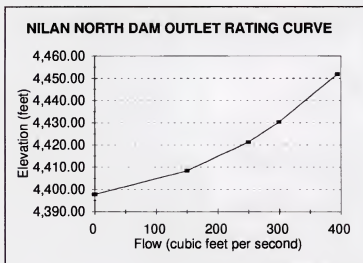
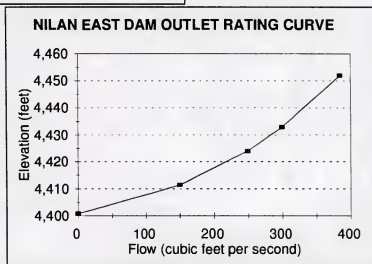
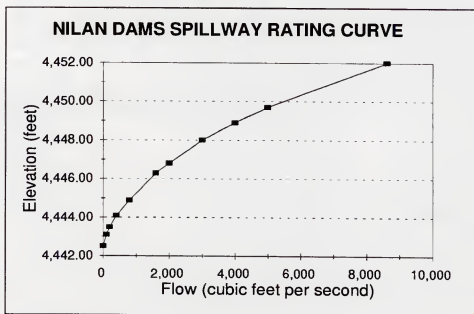
**FIGURE A-1****FIGURE A-2**

TABLE A-4

**NILAN DAMS
SPILLWAY RATING TABLE**

Elevation (feet)	Flow (cfs)
4,442.5	0
4,443.1	100
4,443.5	200
4,444.1	400
4,444.9	800
4,446.3	1,600
4,446.8	2,000
4,448.0	3,000
4,448.9	4,000
4,449.7	5,000
4,452.0	8,620

FIGURE A-3



APPENDIX B

INSPECTION CHECKLIST

DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION
DAM SAFETY INSPECTION REPORT

NAME OF DAM _____
DATE INSPECTED _____

INVENTORY NO. _____
HAZARD CATEGORY _____
TYPE OF DAM _____
YEAR BUILT _____

OWNER _____
OPERATOR _____
STREAM _____
DRAINAGE AREA _____

Reservoir Storage Status

	Water Surface Elevation (feet)	Storage (acre-feet)
At time of inspection	_____	_____
At spillway crest	_____	_____
At min. dam crest elevation	_____	_____
Flashboard crest elevation	_____	_____

ITEM	YES	NO	REMARKS	*ICC
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1. EMBANKMENT

A. Crest -- Height= _____ Length= _____ Width= _____

(1) Any visual settlements?				3
(2) Any misalignments?				4
(3) Any cracking?				1
(4) Any traffic damage?				5
(5) Other?				7

NOTE: *ICC stands for "Inventory Comment Code" which is found on the Inventory of Montana Dams. This comment code is for use by the Dam Safety Section.

ITEM	YES	NO	REMARKS	*ICC
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1. EMBANKMENT (continued)

B. Upstream Face -- Slope=

(1) Any erosion?				19
(2) Any longitudinal cracks?				9
(3) Any transverse cracks?				9
(4) Is riprap protection adequate?				10
(5) Any stone deterioration?				19
(6) Any visual settlement, slumps, sloughing, depressions or bulges?				9
(7) Adequate grass cover?				14
(8) Debris on the dam face?				15
(9) Other?				16

C. Downstream Face--Slope=

(1) Any erosion?				22
(2) Any longitudinal cracks?				19
(3) Any transverse cracks?				19
(4) Any visual settlement, sloughing, slumps, depressions or bulges?				19
(5) Is the toe drain dry?				31
(6) Are the relief wells flowing?				31
(7) Any boils at the toe?				19
(8) Any seepage areas?				17, 18
(9) Any traffic or animal damage?				22
(10) Any burrowing animals?				21
(11) Adequate grass cover?				24
(12) Other?				25

D. Amount and Type of Vegetation on the Dam

	14, 24
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ITEM	YES	NO	REMARKS	*ICC
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2. ABUTMENT CONTACTS

(A) Any erosion?				12, 20
(B) Any visual differential movement?				12, 20
(C) Any cracks?				12, 20
(D) Any seepage present?				36
(E) Other?				16, 25

3. OUTLET WORKS

A. Intake Structure -- Size=

(1) Any settlement?				70
(2) Any tilting?				70
(3) Do concrete surfaces show:				
a. Spalling?				70
b. Cracking?				70
c. Erosion?				70
d. Exposed reinforcement?				70
(4) Do joints show:				
a. Displacement or offset?				70
b. Loss of joint material?				70
c. Leakage?				70
(5) Metal appurtenances:				
a. Any corrosion present?				70
b. Any breakage present?				71
(6) Trash rack?				71
a. Condition?				71
b. Anchor system secure?				71
(7) Other?				71

ITEM	YES	NO	REMARKS	*ICC
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3. OUTLET WORKS (continued)

B. Conduit -- Type = Size =

(1) Do concrete surfaces show:				
a. Spalling?				76
b. Cracking?				76
c. Erosion?				76
d. Exposed reinforcement?				76
(2) Do joints show:				
a. Displacement or offset?				76
b. Loss of joint material?				76
c. Leakage?				76
(3) Is the conduit metal?				76
a. Any corrosion present?				76
b. Protective coatings adequate?				76
(4) Is the conduit misaligned?				76
(5) Any calcium deposits?				76
(6) Other?				76

C. Gates and Tower

(1) Gates:				73, 74
a. Size: Operating:			Emergency:	
b. Type: Operating:			Emergency:	
(2) Controls operational?				75
(3) Controls lubricated?				75
(4) Operational problems?				76
(5) Leakage around gates?				73, 74
(6) Condition of gate seals?				73, 74
(7) Any cavitation damage? If so, describe?				73, 74
(8) Describe air vent-size and condition.				73, 74

ITEM	YES	NO	REMARKS	*ICC
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3. OUTLET WORKS

C. Gates and Tower (continued)

(9) Is there a jet pump?				82
a. Is it operational?				82
b. Leakage?				82
(10) Is the tower dry? wet?				77
(11) Any seepage in the tower?				77
(12) Condition of the tower?				77
(13) Any safety problems?				77
(14) Ladder in good condition?				77
(15) Condition of the gate house?				81
(16) Emergency plan completed for the dam?				43
a. Posted in the gatehouse?				43
(17) Other?				82

D. Stilling Basin

(1) Do concrete surfaces show:				
a. Spalling?				82
b. Cracking?				82
c. Erosion?				62
d. Exposed reinforcement?				82
(2) Do joints show:				
a. Displacement or offset?				82
b. Loss of joint material?				62
c. Leakage?				62
(3) Do energy dissipators show:				
a. Signs of deterioration?				62
b. Are they covered with debris?				62
(4) Other?				63

ITEM	YES	NO	REMARKS	*ICC
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3. OUTLET WORKS (continued)

E. Downstream Channel

(1) Is the channel:				
a. Eroding or backcutting?				38
b. Sloughing?				38
c. Obstructed?				40
(2) Is released water:				
a. Undercutting the outlet?				52, 62
b. Eroding the embankment?				52, 62
(3) Other?				56, 63

4. SPILLWAY

A. Description

(1) Location?				N/A
(2) Type of Spillway?				N/A
(3) Size of Spillway?				N/A
(4) Spillway lining?				N/A
(5) Is there a weir?				61
(6) Is the spillway in good condition?				N/A
(7) Any drains?				N/A
a. Describe the condition of drains.				64

B. Does spillway show:

(1) Any cracking concrete?				57, 58
(2) Any spalling concrete?				57, 58
(3) Any exposed reinforcement in the concrete?				57, 58
(4) Any erosion?				52

ITEM	YES	NO	REMARKS	*ICC
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4. B. Does spillway show: (continued)

(5) Any slope sloughing?				51
(6) Any obstructions?				54
(7) Displacement or offset joints?				59
(8) Loss of joint material?				57, 58
(9) Leakage at the joints?				57, 58
(10) Other?				63

C. Do the energy dissipators show:

(1) Signs of deterioration?				62
(2) Any cracking?				62
(3) Any spalling?				62
(4) Any exposed reinforcement?				62
(5) Are they covered with debris?				62
(6) Other?				64

D. Has release water:

(1) Eroded the embankment?				52
(2) Undercut the outlet?				52
(3) Eroded the downstream channel?				52
(4) Other?				56

E. Emergency Spillway

(1) Is there an emergency spillway?			(If YES, describe)	55

ITEM	YES	NO	REMARKS	*ICC
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5. RESERVOIR CONTROL

(A) Recent upstream development?				47
(B) Recent downstream development?				48
(C) Slides in reservoir area?				44
(D) Change in reservoir operation?				48
(E) Large impoundment upstream?				49
(F) Any debris in the reservoir?				50
(G) Other?				50

6. INSTRUMENTATION

(A) List type(s) of instrumentation:				27-33
(B) In good condition?				27-33
(C) Read periodically?				27-33
(D) Is data available?				27-33
(E) Include all data gathered since last report.				

7. DOWNSTREAM CONDITION

A. Downstream Land Use.

	41
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This dam was inspected by:

Additional comments and recommendations. (Use additional pages)





